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Climate Monitoring from Space – Architecture for Sustained Observations

John J. Bates

National Climatic Data Center, NOAA/NESDIS, Asheville NC

1. Overview

The task of climate monitoring has requirements that extend beyond the current paradigm of one-time research missions and operational satellite systems in existence today. Recognizing these needs, international research and operational Space Agencies, the Committee on Earth Observation Satellites (CEOS) and Coordination Group for Meteorological Satellites (CGMS), have formed a new Working Group on Climate that has defined an architecture that ensures delivery of sustained observations over the time frames required for analysis of the Earth's climate system. An architecture typically describes the structure of a system, as reflected in its building blocks, their relationships to each other, and to the environment. The descriptive format of the architecture is generally tailored to the particular needs of the users/stakeholders and makes use of common definitions and standards in its construction.

2. Why is an architecture needed?

Based on discussions within the various climate monitoring working groups and related meetings, two main needs/usage scenarios for an architecture have emerged:

1. To promote a common understanding, amongst the various stakeholders, of the implementation implications of meeting the various climate monitoring requirements. To support such a usage, the architecture should depict, in a structured and readily-accessible format, the functions, information flows and dependencies of the processes necessary to satisfy the relevant requirements and support the verification by the originators/owners of the requirements that they have been correctly interpreted. While this should encompass the end-to-end climate monitoring processes (*e.g.* from sensing right through to decision-making), the initial emphasis is expected to be placed on representing the upstream processes (*i.e.* sensing and climate data record creation).

2. To support an assessment of the degree to which the current and planned systems meet the requirements, and the generation of an action plan to address any identified shortfalls/gaps. It is anticipated that such an action plan would help promote the fulfilment of user needs through the coordinated implementation of activities across agencies.

Based on the two identified usage scenarios, an architec¬ture with two main "views" is proposed:

- A Logical View;
- A Physical View.

The logical view serves the first usage scenario (Fig. 1). It represents the functional and data-flow implications of the requirements baseline as a set of interlinked functions and associated data-flows. Leaving aside performance considerations (*e.g.* accuracy, uncertainty, stability, coverage *etc.*), the logical view could be considered as the "target" for a climate monitoring system and, in the sense that it is applicable to all Climate Data Records, this representation is generic. As this view is intimately tied to the requirements baseline (and not to the physical implementation of a climate monitoring system) this view is as stable as the requirements baseline and, once established, should only need to be updated when the functional aspects of the requirements change.

In contrast, the purpose of the physical view, which supports the second usage scenario, is to describe the current and planned implementation arrangements for each essential climate variable, including how the

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Correspondence to: John J. Bates, National Climatic Data Center, NOAA/NESDIS, Asheville NC;
E-mail: John.J.Bates@noaa.gov.

various functions of the logical view are/will be physically implemented. As this physical view tracks the evolving implementation of the climate monitoring system, it will need to be regularly updated (*e.g.* once a year).

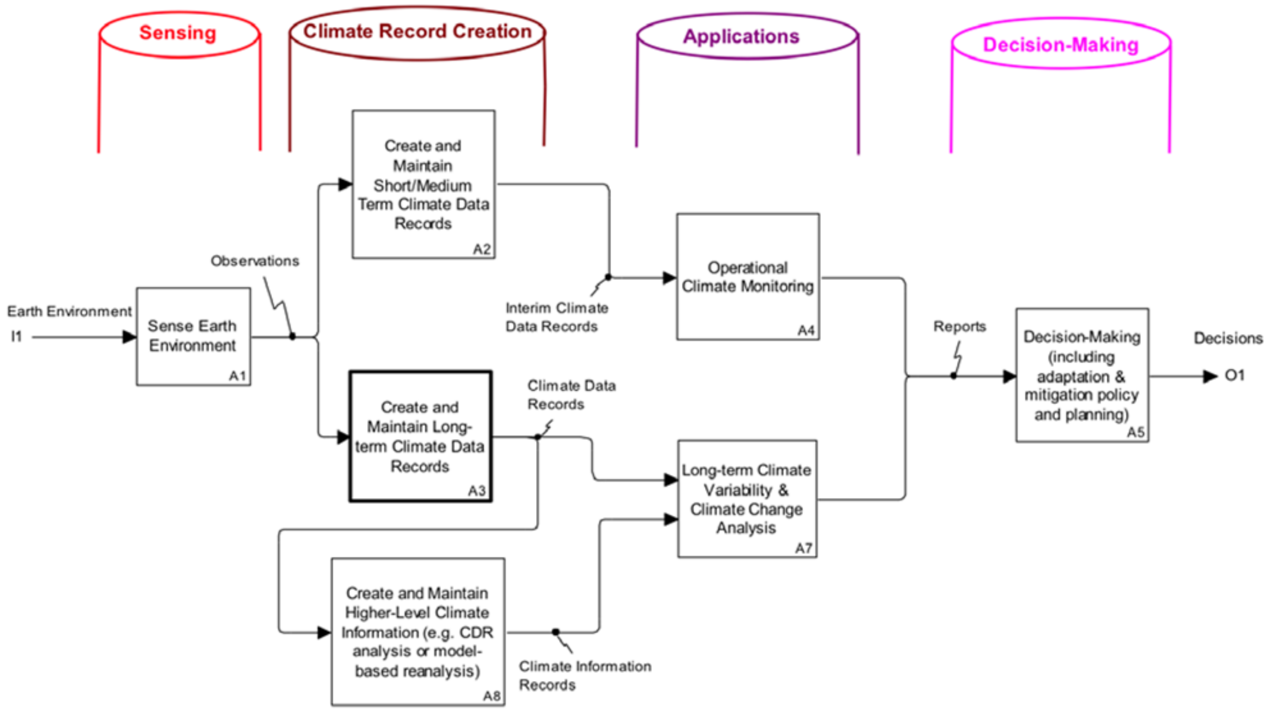

Fig. 1 Schematic of the Logical Architecture for climate monitoring including the four pillars required for monitoring and decomposition steps for creation and applications.

3. Conclusions

A new Space Agency Working Group on Climate has written and released a report on a ‘Strategy Towards and Architecture for Climate Monitoring from Space’. The report establishes a framework for international collaboration to address critical issues such as:

- In general, current observing systems have not been primarily designed with a climate perspective, therefore, inventories are needed to document the contributions of current and planned observing systems for climate purposes.
- Requirements for mission continuity and contingency need improvement through international collaboration of space agencies.
- Sustained Climate Data Record (CDR) programs will provide an avenue to replace heritage algorithms and data sets with improved versions once they are successfully demonstrated, validated and available.
- There is an imperative to ensure traceability along harmonized practices.
- It is hoped that the report will help establish a basis for sustained and routine climate monitoring from space similar to the World Weather Watch. The full report can be found at:

  http://www.ceos.org/images/strategy_towards_architecture_hig_rez_V10_high_rez.pdf.